



***TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.***

## **Tank Automotive Research, Development & Engineering Center (TARDEC) S&T Investments**

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**24 May 2011**

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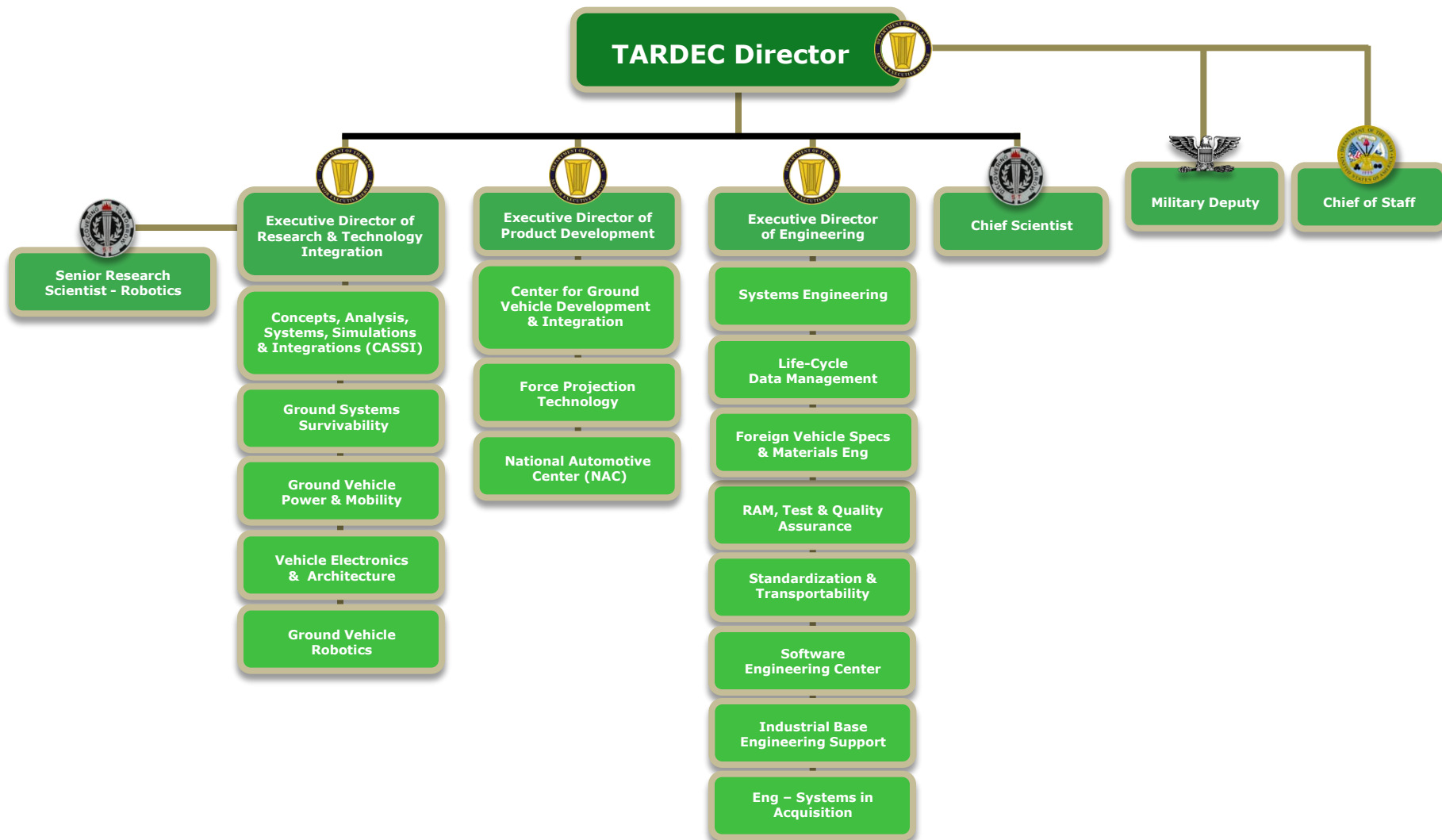
- Provides full life-cycle engineering support and is provider-of-first-choice for all DOD ground combat and combat support vehicle systems.
- Develops and integrates the right technology solutions to improve Current Force effectiveness and provide superior capabilities for the Future Force.



Responsible for Research, Development and Engineering Support to **2,800** Army systems and many of the Army's and DOD's Top Joint Warfighter Development Programs

unclassified

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**





**Ground Systems  
Survivability Integration**

**Vehicle Electronics &  
Architecture Integration**

**Ground Systems  
Power & Mobility Integration**

**Maturation of Ground Robotics  
& Vehicle Situational Awareness**

**Development of Force  
Projection Technology**

**Systems Engineering & Integration Excellence Across the Life Cycle**

**TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.**



## Advanced Concepting



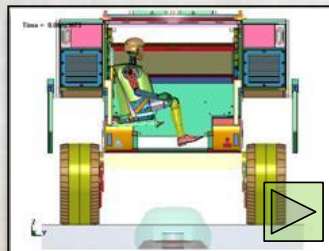
JLTV



FED

MRAP

## Analytics



Blast



Structures/Durability



Crew Safety

## Hardware & Man-In-The-Loop Simulation



MRAP



Turret Test



Characterization

## Prototype & Demonstrators



TWVS

APD

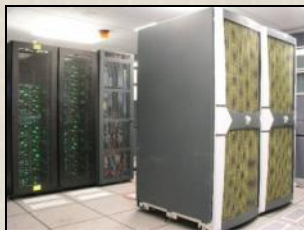


FED

## HPC & Data Management



High Performance Computing (HPC)



Computer Aided Virtual Environment (CAVE)



Advanced Collaborative Environment (ACE)



**Providing Rapid Assessment and Integration Services throughout the Life Cycle of both Technology and System/Platform Development Programs.**



## System & Simulation Integration Laboratories



## Physical Simulation Laboratories



## Fuels & Lubricants Laboratories



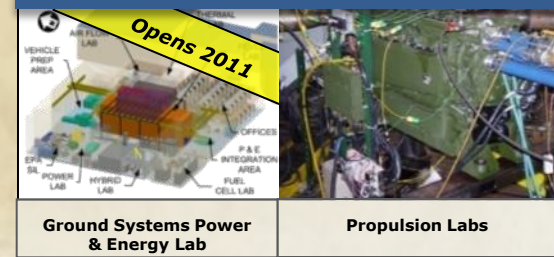
## Survivability Laboratories



## Prototype Integration



## Power & Energy Laboratories

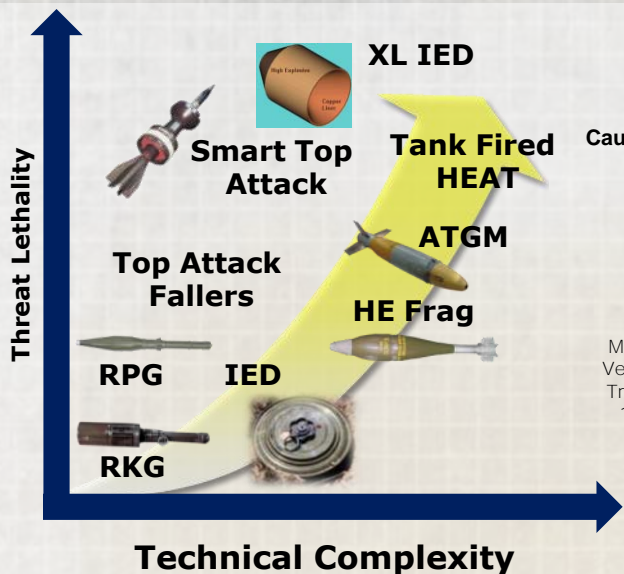


**TARDEC's Warren, MI operations has a resource value of over \$950M and occupies 12 facilities on the Detroit Garrison totaling over 840,000 square feet of laboratory space**

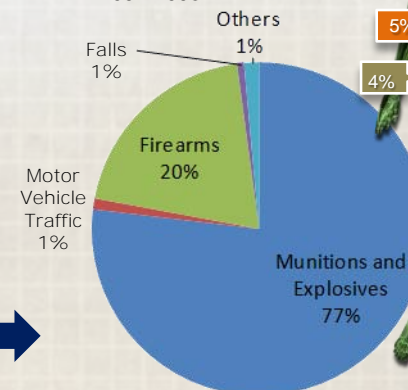




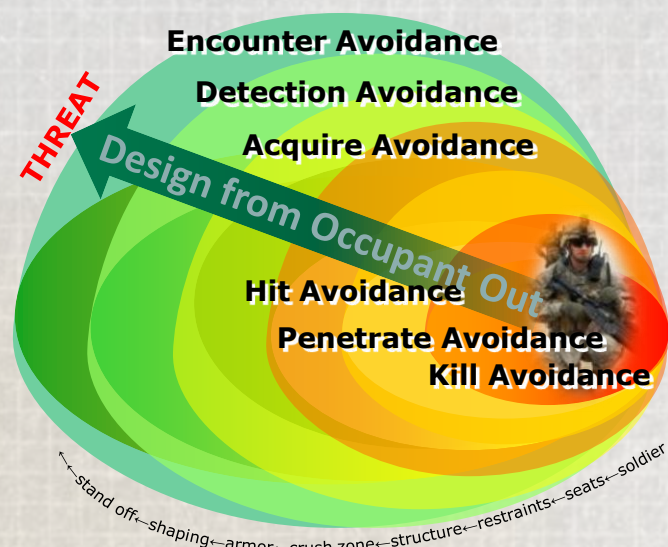
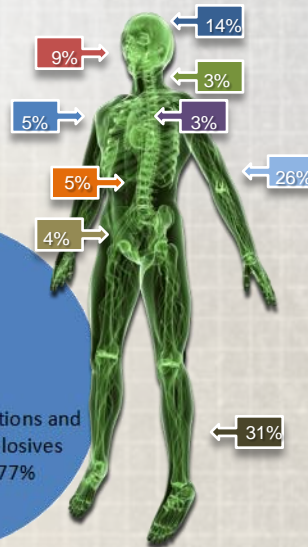
# Excellence in Ground Systems Survivability Occupant Centric Vehicle Protection



Cause Agent Breakdown (BI)  
2002-2008



N = 7,092 patients



**Increasing Demands and Operational Flexibility  
Require Strategic Investments in Key Areas**



**Kill Avoidance**



**Penetration Avoidance**



**Hit Avoidance**

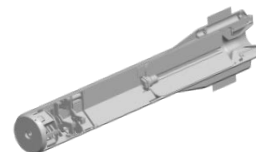
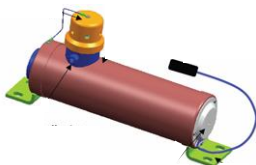
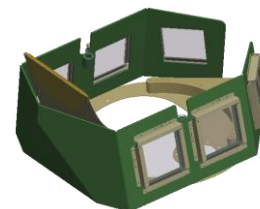
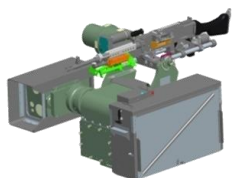


**Detection Avoidance**

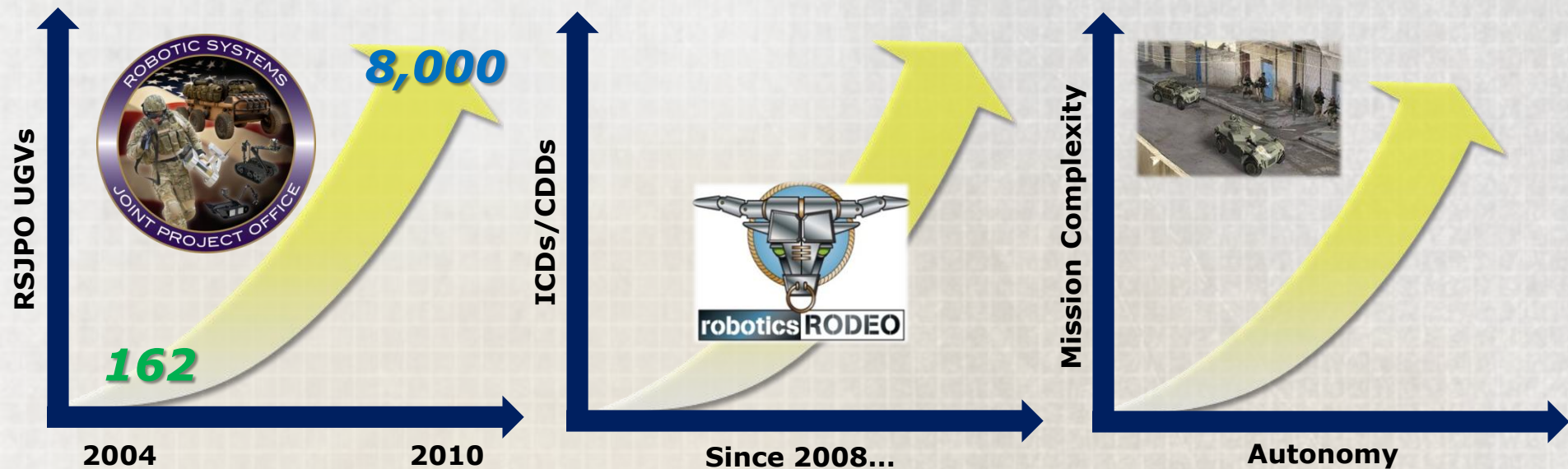




# Integration for Survivability



**It's about balancing integration, mission, threat & technology**



## Increasing Demands and Operational Flexibility Require Strategic Investments in Key Areas



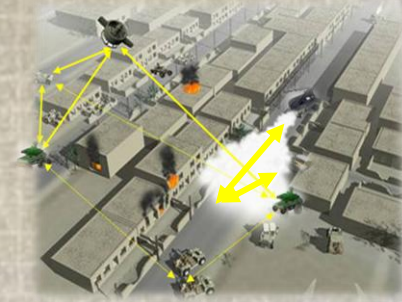
**Reliable operations**



**Intelligent Control**



**Lighten the Load**



**Collaborative  
Interoperability**



## Far Future

### Collaborative Autonomy

- Mixed Assets (UGV, UAV, UUV)
- Auto. Mission Plan & Delegation
- *Global Urban Ops/Border Security*



## Near/Far Future

### Autonomous

- "Hands-Off" Mission Execution
- Human Intent Recognition
- Urban Ops/Robotic Wingman



## Current/Near

### Supervised-Autonomy

- Plan, Observe and Go;
- Road Rules Recognition & Follow
- Convoy Ops & Route Clearance



## Current/Near Future

### Tele-Op with Intelligence

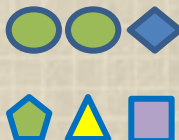
- Persistent Stare
- Range Clearance
- Retro-Traverse
- Navigational Blackboard
- Warehousing/Logistics



## Current

### Tele-Op w/o Intelligence

- IED / EOD Missions
- Engineering Functions



## Current

### Remote Control

- Vehicle /Security Checkpoint



- = Fielded JUONS/ONS/UUNS/UNS
- = JUONS/ONS/UUNS/UNS
- = Draft/Future Requirement
- = Current Requirement/POR

Increasing Autonomy

- Affordable common robotic kit for manned/unmanned operations of current force vehicles
  - Incremental insertion of safety and automation capabilities
- Manned-unmanned and UAV-UGV collaboration for enhanced company operations
- Open systems architecture and joint interoperability
- Multi-mission capable family of robotic platforms
- Safe semi-autonomous operations in complex/dynamic environments
- Scalable autonomy based on terrain and mission understanding
- Robotic security for maneuver elements





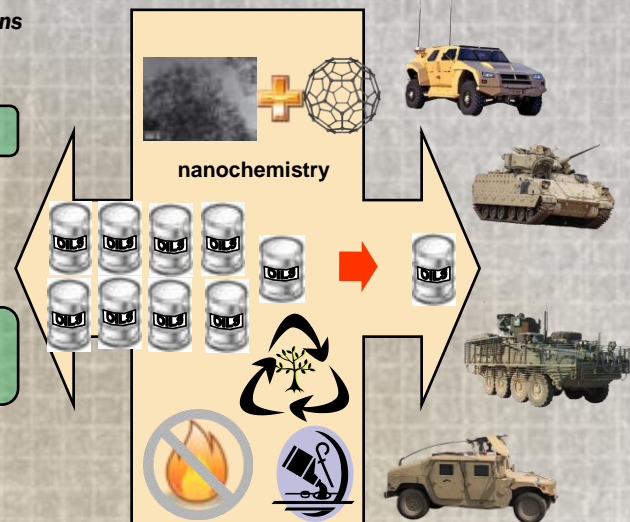
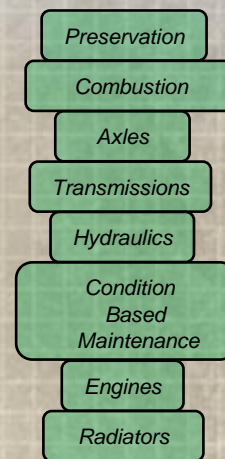


## Next Generation Technologies

- Alternative Fuels
- Fuel Additive Technologies
- Fuel Efficient Powertrain Lubricant
- Nanotechnology for Fuels and Lubes
- Water from Air
- Water Reuse
- In-line Water Monitoring
- Fuel and Water Remote Quality and Quantity Surveillance
- Mechanical Countermine Increased Stand-off
- Structural Health Monitoring of Bridging
- Rapid Military Load Class Determination
- High Performance Materials for Lightweight Bridging & POL Storage Applications
- Priority Hydraulic System Combat Engineer (CE) & Hydraulic Hybrid Material Handling Equipment (MHE)
- Semi-Autonomous: CE, MHE, Bridging, Mechanical Countermine

## POL Technology

### Potential Applications



### Mechanical Countermine



### Petroleum Supply



### Water Supply

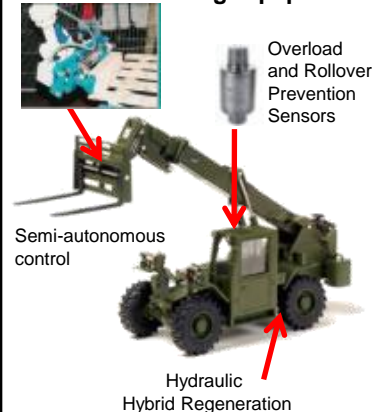


### Bridging

#### Basic Building Blocks (Optimum Design)



### Combat Engineering and Material Handling Equipment







# Excellence in Vehicle Mobility & Energy Efficiency



**Increasing Demands and Operational Flexibility  
Require Strategic Investments in Key Areas**



Energy Storage



Power Generation  
& Control



Thermal Management



Track & Suspension



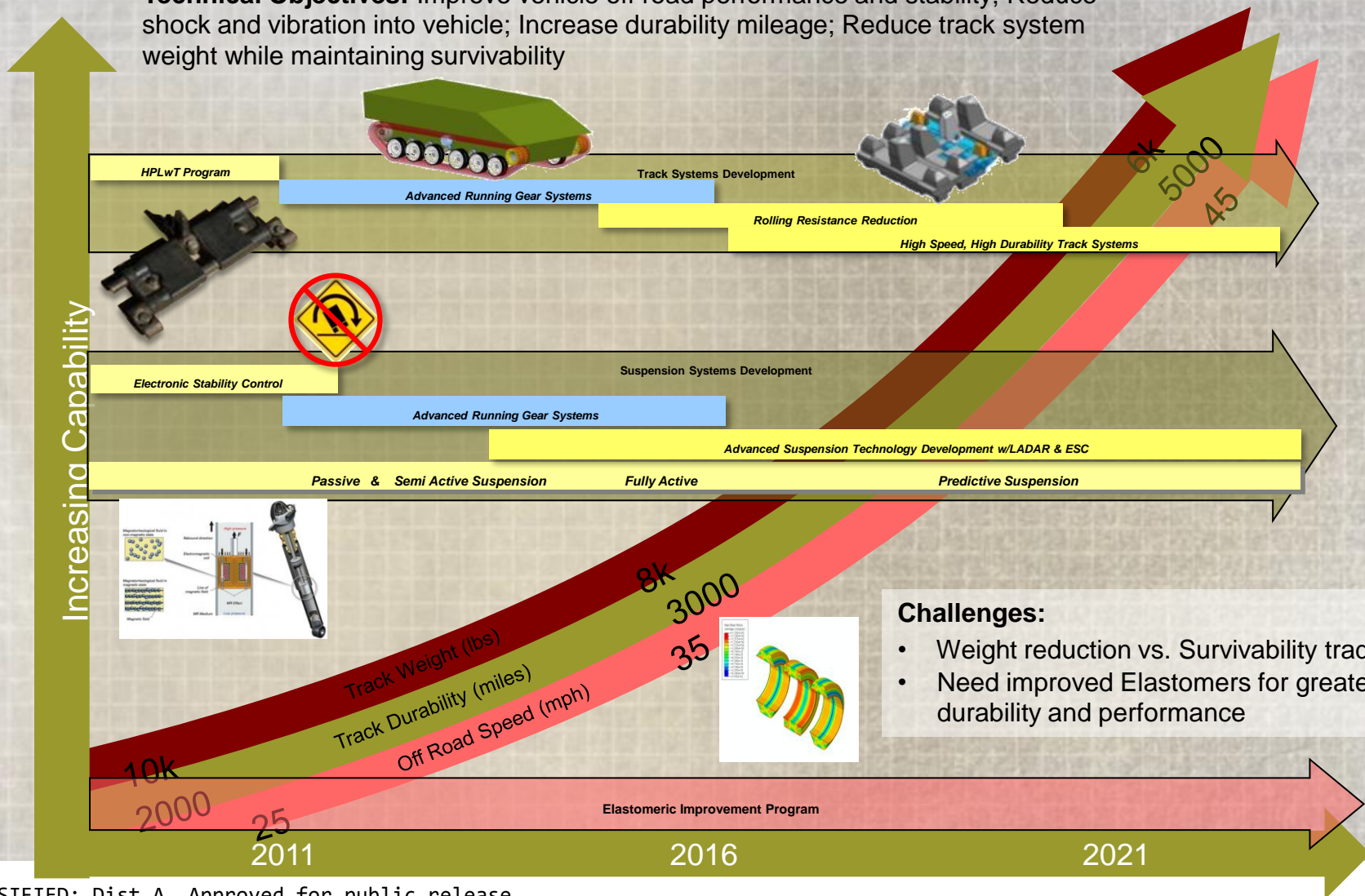


# Current Efforts to Increase Vehicle Agility



**Operational Objective:** Combat and Tactical vehicles able to maneuver quickly and safely in any terrain

**Technical Objectives:** Improve vehicle off road performance and stability; Reduce shock and vibration into vehicle; Increase durability mileage; Reduce track system weight while maintaining survivability



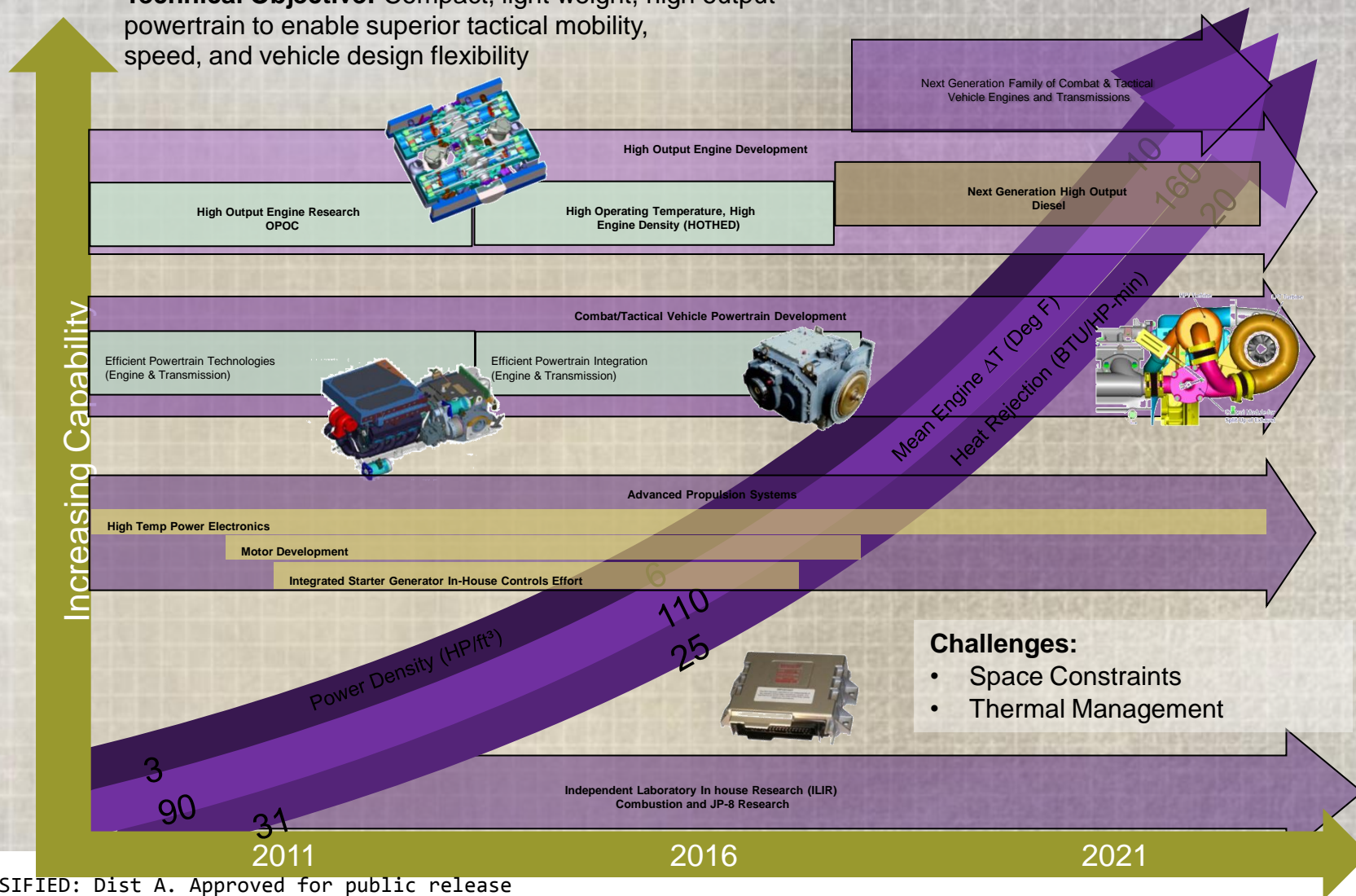


# Current Efforts to Increase Prime Power



**Operational Objective:** Provide the required platform power to deliver the mission payload to the target

**Technical Objective:** Compact, light weight, high output powertrain to enable superior tactical mobility, speed, and vehicle design flexibility







# Current Efforts to Reduce Fuel Consumption

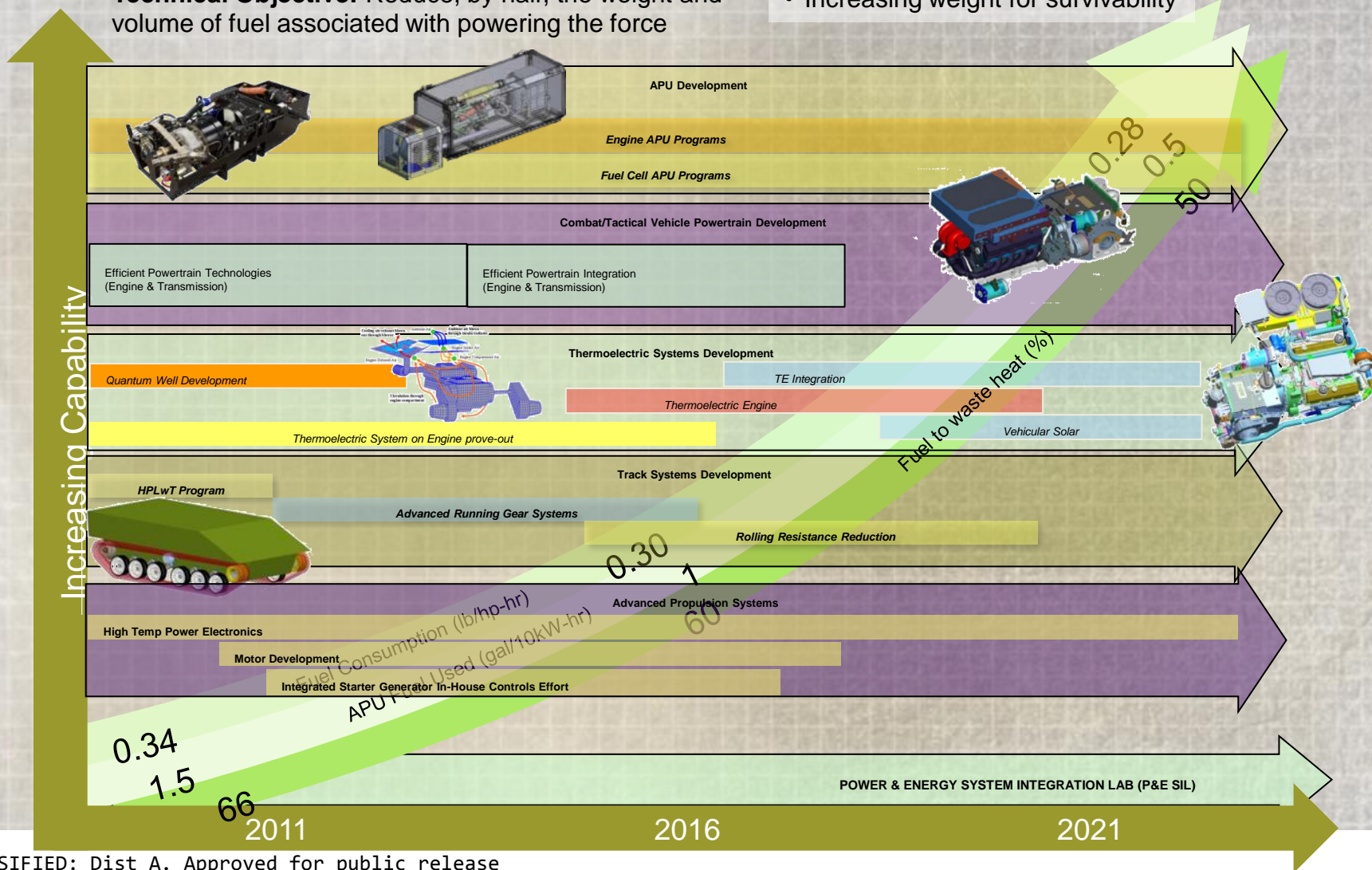


**Operational Objective:** Two battlefield days of operations without refueling

**Technical Objective:** Reduce, by half, the weight and volume of fuel associated with powering the force

## Challenges:

- Increasing demand for power
- Increasing weight for survivability



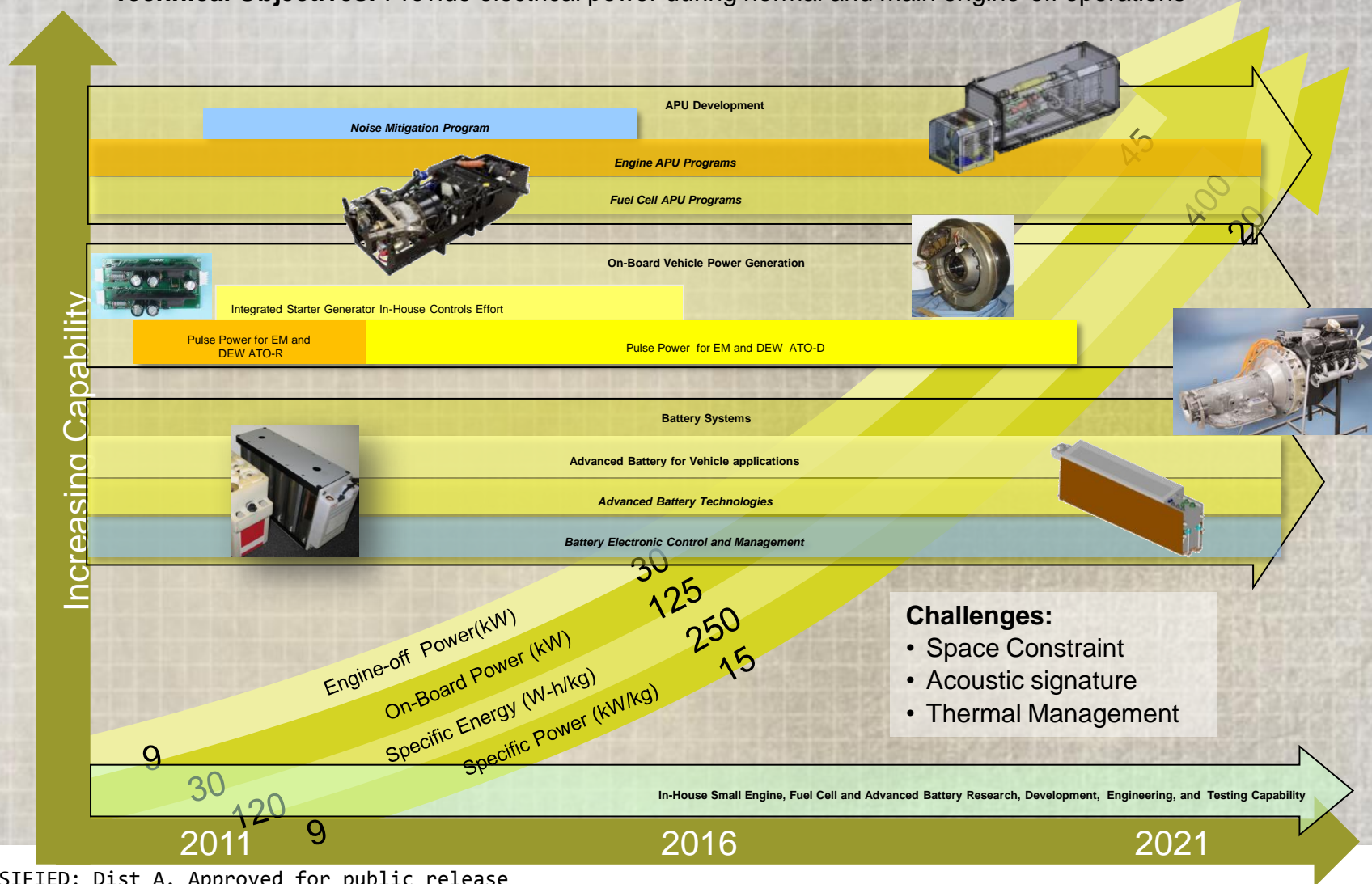


# Current Efforts to Increase Electrical Power



**Operational Objectives:** Eight hours of silent watch; Sufficient on/off board electrical power for superior lethality, C4ISR, survivability and force protection

**Technical Objectives:** Provide electrical power during normal and main engine-off operations





	Primary Interest	
<b>1) Advanced combustion engines and transmissions</b>	High density, energy efficient powertrain	Extreme gains in engine efficiency
<b>2) Lightweight structures and materials</b>	Reduce weight to improve performance	Cost reduction for consumer market
<b>3) Energy recovery and thermal management</b>	Improved efficiency, manage heat generation	Efficiency gains through waste heat recovery
<b>4) Alternative fuels and lubricants</b>	Standardization & security	Efficiency gains for the legacy fleet
<b>5) Hybrid power systems</b>	Efficiency improvements	Efficiency improvements
<b>6) Analytical Tools</b>	Assessment/Design Trades	Assessment/Design Trades

# It's All About the Warfighter

